

**【ABSTRACT】**

A three-dimensional (3D) photonic quantum ring (PQR) laser for a low power consumption display, wherein the PQR laser has a sufficient small radius to adjust an inter-mode spacing (IMS) of oscillation modes discretely multi-wavelength-oscillating in an envelope wavelength range within the gain profile of a given semiconductor material of the PQR laser so that the IMS has a maximal value and the number of the oscillation modes is minimized. The PQR laser exhibits multi-wavelength oscillation characteristics according to a 3D toroidal cavity structure, and is designed to exhibit a threshold current lower than those of LEDs and to have multi-wavelength modes in an envelope wavelength range of several nm to several tens of nm. The PQR laser consumes reduced power while maintaining desired color and high brightness equal to those of the LEDs, through an adjustment of the multi-wavelength oscillation characteristics and IMS of the PQR laser.